# Multiple Perspectives on Children's Object-Centered Learning

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**University of Michigan and the Ann Arbor Hands-On Museum**
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## Problem

Children's hands-on learning is the foundation for many children's museums and science centers. Exploration, play, and discovery are important activities for children and it is widely believed that children learn more by interacting directly with objects rather than viewing them passively. It is also believed that children find object-centered experiences motivating ways to discover concepts and relations about science, history, art, and other subjects. These direct experiences with objects are first-order interactions that can be contrasted with second-order interactions, such as indirect experience through text, images, and discussion. Traditional approaches to children's learning emphasize the importance of play during early childhood but the emphasis shifts to second-order experiences in school where text-based learning predominates. There are challenges to this traditional view on several grounds. Within schools, learning seems to be more motivating and engaging when it is based on inquiry, projects, and research involving authentic problems and objects (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991). Outside schools, children's learning depends on features of intrinsic motivation such as their enjoyment, challenge, choice, and control (Csikszentmihalyi, & Hermanson, 1995; Paris, 1997). The benefits of these first-order experiences with objects is perhaps most evident in informal learning environments (ILEs) such as museums, zoos, science centers, aquaria, and gardens. Despite the importance of object-centered learning for both academic and life-long learning, there is surprisingly little research on the topic. That was one of the main reasons for convening an NSF conference on the topic.

## Conference

In January 2000 the National Science Foundation sponsored a conference on children's object-centered learning at the Ann Arbor Hands-On Museum and the University of Michigan. More than 60 faculty, graduate students, and museum professionals attended the two-day conference. (See Appendix for the complete list of participants and their affiliations.) Participants included national and international experts who gave presentations on various aspects of children's learning with, through, and about objects in venues that included art museums, history museums, science centers, children's museums, gardens, arboreta, and schools. Each day of the conference included (a) brief presentations of research programs and issues surrounding children's learning through objects, (b) break-out groups for concentrated analyses, and (c) museum browsing and discussions with colleagues. Throughout the conference, we tried to synthesize our own first and second-order experiences with objects into questions that would lead researchers and museum educators in fruitful directions.

Our goal for the conference was to brainstorm ideas about children's learning in new ways. Our discussions had implications for museum education, programming, and exhibit design as well as school-based learning. The ideas are relevant to NSF goals to promote education, especially (a) transitions from school to the workplace, (b) life-long learning, and (c) creating informal learning environments rich with objects and experiences as teaching tools. The conference focused on children's experiences with objects in museums, gardens, schools, and community settings and how they interact with objects to learn about them and learn through them. We questioned the use of genuine vs reproduced artifacts, examined the use of virtual images through technology, outlined the need for disciplined inquiry, asserted the usefulness of narrative frames of reference, and discussed the aesthetic impact of objects. The diverse perspectives of the participants prompted vigorous discussions and new orientations to traditional approaches to hands-on exhibits. As examples of the targets of some of our discussions, the foci of the break-out groups were; Interactive & Hands-On Exhibits, Inquiry & Discovery, Aesthetics & Visual Thinking, Objects: Real, Sacred, & Virtual, Material Culture Represented in Objects, Museum-School Connections, Docents & Explainers, and Families & Children. Each of the break-out groups discussed core problems and issues in their topics and promising approaches. Notes were taken during the sessions and reporters from each group summarized the key points that were identified. Several of these reports are summarized below to indicate the kinds of issues that were raised and suggestions offered.

### Aesthetics & Visual Thinking

#### *Core issues*

- What kind of person are we growing?
- What are the underlying assumptions of aesthetics in art, technology, sciences?
- Do current theories provide adequate theories of aesthetic development?

Aesthetics in children

- • Need to avoid "Disneyizing" museums for children.
- • Make experiences rich and child-centered.
- • Provide for a sense of awe and wonder.
- • Design environments that encourage visual analyses and communication among visitors.

#### *Promising Approaches*

- Social communication and discourse about aesthetics.
- Focus on beauty and appreciation.
- Provide experiences that emphasize aesthetics.
- Consult with children about design and presentation.

- Focus on richness, reality, complexity, involvement, beauty, free choice, and openness.
- Collect empirical evaluations of aesthetic experiences.

**Museum-School Connections: Group #1**

What is the role of the museum in formal education?

- Different places emphasize educational or cultural missions to different degrees.
- Make staff and collections available
- Articulate museum values & functions.
- Define roles for teacher training, both pre-service and inservice.
- Define role of museum for after-school and home-school movements.

How can disciplinary perspectives influence interactions with objects?

- Teach visitors to appreciate primary sources like historians.
- Teach visitors to apply scientific method in science museums.
- Teach aesthetic and artistic appreciation in art museums.
- Disciplined inquiry refers to "thinking with skills and expertise of the discipline" and also "effortful and strategic" viewing of objects.

**Museum-School Connections: Group #2**

- If teachers do not see value in museum visits, then students won't.
- Exposure to museum is launching point to go beyond the classroom.
- Connect exciting science experiences in museums to school experiences so children are successful in both places.
- Need to identify what objects are significant for learning in school.
- Need to identify how school reform can be supported by museums and object-centered learning.
- Provide outreach experiences from museums to schools if schools cannot visit museums.
- Maximize real world contexts to provide models for careers.
- Work with schools to enrich children's experiences through family and community.
- Identify what each museum does very well and work to link that to school curricula.
- Collaborate with many museums and school districts to identify shared interests and resources.
- Museums make excellent sites for teacher training but need sustaining partnerships.
- Need to have models of effective practices to avoid reinventing the wheel.
- Need partnerships between schools and museums to train museum staff to provide good educational opportunities that link to schools.
- Need problem-solving focus in museums rather than static displays.
- Need to worry about equity and equal opportunity for children to have access to museums.

**Families & Children**

Museums must address all ages.

- Assess the target population and insure age appropriateness of exhibits.
- Create separate environments for young children.
- Design exhibits for collaborative experiences with entire families.

Play is important.

- Play is learning for young children.
- Design playful experiences for older visitors too.

Promising New Directions

- Unit of analysis is shifting to the social group and family.
- Create multiple visit model for families.

- Create exhibits that reflect contemporary issues such as gender, violence, & social issues.

## Background on Children's Learning with Objects in Informal Learning Environments

Opportunities to learn with other people in community settings beyond home and school provide significant experiences in the lives of children. For example, there are more than 500 million visitors each year to American museums (Hein & Alexander, 1998). There are nearly 300 science museums in America and half of their visitors are under 18 years of age. Cleaver (1992) describes 265 hands-on museums built on the principle of "hands-on = minds-on", a philosophy related to theorists from Dewey to Montessori to Piaget to Duckworth to Gardner. Museums, of course, include buildings specifically designed for children, as well as buildings that house artifacts of art, science, history, and so forth. The more inclusive term is "informal learning environments" (ILE) which refers to various settings such as museums, zoos, aquaria, national parks, and botanical gardens. We can also extend ILEs to encompass community institutions such as libraries, churches, and community centers; community events such as music and cultural festivals; and groups such as Scouting and youth organizations because they all involve gatherings outside home and school to share new experiences (Forman, Minick, & Stone, 1993; Villarruel & Lerner, 1994). These contexts provide incredibly rich and diverse opportunities for learning and are ubiquitous in children's lives.

Moreover, as families pursue venues for recreation and leisure, they increasingly seek these environments as destinations. Why? Because parents regard the visits as enculturating experiences for children to learn about history, science, and art with authentic artifacts and knowledgeable experts. These contexts extend and complement parental values and instruction; they are activities that can fuel children's aspirations as well as bolster personal, family, and cultural identity. A visit to the Museum of Science and Industry in Chicago or the Museum of Modern Art in New York may transform children's knowledge and notions of possible selves as much as a visit to the Statue of Liberty or the Holocaust Memorial may stimulate national or religious identity. One purpose of this paper is to identify mutually important topics in museum education, child development, and educational psychology because detailed studies of the social, cognitive, and developmental aspects of children and families exploring these environments can enrich theories and applications in many fields.

## Features of Informal Learning Environments

Informal learning environments (ILEs) are difficult to define but are usually contrasted with formal learning opportunities in school. For example, Resnick (1987) noted that learning outside school emphasizes shared cognition, tool manipulation, contextualized reasoning, and situation-specific competencies in contrast to individual cognition, pure mentation, symbol manipulation, and generalized learning in school. However, it seems that in both schools and museums, on some occasions and in some places, learning might be more or less structured and guided, more or less formal. ILEs are also difficult to specify because learning is a broad term that encompasses many outcomes. Visiting nature parks can lead to restorative feelings (S. Kaplan, 1995) but is it learning? Participating in Girl Scouts may lead to better managerial skills and citizenship but is it learning (Edwards, 1994)? Visiting the Vietnam Memorial may move people to tears but is it learning?

Part of the problem, of course, is defining learning but part of the problem is the blurry lines between learning and development, education and entertainment, memory of facts and memory of cumulative experiences, and knowledge acquisition and affective outcomes. Despite the difficulties in classification and boundaries, ILEs are generally characterized as learning based on objects and experiences rather than text, perhaps the key distinction between traditional school and non-school learning. ILEs provide authentic artifacts and allow children to determine their own goals for exploration, discovery, and learning. Falk and Dierking (1998) prefer the term "free-choice learning" to informal learning because visitors have choice and control in ILEs. Paris (1997) describes situated motivation in museums according to the visitor's opportunities to construct personal meaning, make choices, exercise control, engage in collaboration and conversation, adjust task challenges, and derive consequences of performance that promote self-efficacy. Gardner (1991) argued that schools might be more inviting and more effective if they resembled museums. He noted that "...science museums and children's museums have become the loci for exhibitions, activities, and role models drawn precisely from those domains that do engage youngsters; their customary wares represent the kinds of vocations, skills, and aspirations that legitimately animate and motivate students" (Gardner, 1991, p.202).

Trying to understand the impact on a person of a visit to an ILE begins with a description of the situation and the experiences afforded by elements in the setting. The analogy to perceptual affordances is important because just as objects afford certain properties such as surface or support, a situation affords or promotes certain types of interactions and experiences. For example, standing on the deck of a reconstructed slave ship or descending into a replica of a coal mine can elicit strong emotional reactions. The situations are in fact designed to afford and evoke visitors' reactions. The authenticity of the artifacts and the affordances of the ILE foster the acquisition of knowledge because of the embeddedness of the desired knowledge and responses in the situation. This necessary embeddedness of learning and development in practical experiences is the centerpiece of theories of situated learning (Lave & Wegner, 1991) and apprenticeship (Rogoff, 1990) and illustrates the potential linkages among research in ILEs and contemporary developmental theories.

Studies of ILEs extend beyond affordances and practices; they must include examination of the motives of the person in the situation and the ways that meaning is created. This is the fusion of theories of practice and meaning-making. For example, contemporary theories of children's motivation are almost entirely based on achievement strivings and failure avoidance because they emanate from research in schools. Theories of mastery motivation, expectancy-values, self-efficacy, or attributions were derived from academic settings and may not generalize much beyond them. Our notions of children's motivation would be enriched considerably if theories were designed to explain behavior in ILEs and non-school contexts. Consider some of the motives for people to visit museums noted by Roberts (1997): social interaction, reminiscence, fantasies, personal involvement, and restoration. These goals for seeking and immersing oneself

in ILEs need to be studied in order to understand why children choose to spend their time in certain groups, activities, and environments beyond school.

We want to promote research in community contexts of learning beyond the school and home because they have been neglected from basic psychological research and because the contexts are fertile grounds for building theories of learning, motivation, and socialization based on children's common experiences. Despite occasional studies of children and families in museums during the past 70 years (see Hein & Alexander, 1998), only recently have researchers begun systematic research and theorizing in informal environments (e.g., Matusov & Rogoff, 1995; Schauble, Beane, Coates, Martin, & Sterling, 1996). The rationale for this new area of research is predicated on the following claims: (1) children spend an increasing amount of leisure and family time in ILEs, (2) children in ILEs are exposed to objects and experiences that are unique, culturally informative, and afford construction and sharing of meanings, (3) children in ILEs encounter experts, teachers, craftspeople, artisans, artists, and role models that are often unavailable to them at home and school, (4) ILEs provide natural community venues for familial and intergenerational learning, (5) ILEs provide grounds for theory building that complement extant theories of formal learning and motivation in schools, (6) ILEs afford learning with technology through practice and social collaboration, and (7) ILEs can have cumulative and life-long effects on people's aspirations, values, and interests.

We will highlight fruitful areas for research on children in ILEs that illustrate how developmental processes and outcomes can be shaped by experiences in these contexts. Each area is noted briefly to illustrate the kinds of research and topics relevant to children that could be investigated. The topics include: (a) learning about objects, (b) inquiry-guided learning, (c) aesthetic development, (d) family interactions, (e) using technology, and (f) transformative personal experiences.

## Learning with Objects

The raison d'être of any museum is the collection of objects. The objects might reflect a discipline, person, or historical events but the distinctive aspect of most museums is the collection and display of objects which is the basis for a public interface (Carr, 1991). It seems strange that so little attention has been paid to the nature of children's learning about, with, and through objects. Tudge and Winterhoff (1993), in a discussion of Vygotskian notions of the culturally and socially embedded nature of cognitive development, say that "social and cultural institutions, technologies, and tools channel the nature and focus of interpersonal interactions, which in turn mediate the development of children's higher mental functions..." (p. 66). Developmental research usually assigns object-based learning to an elementary stage of thinking that is concrete rather than symbolic in which learning is due to trial-and-error rather than systematic experimentation but this ignores how children become skilled at viewing objects or inferring their uses and history. Sometimes the developing expertise about viewing objects is described as "museum literacy" or "visual literacy" but there is much more that needs to be studied from a developmental perspective. How do children handle, discuss, and assemble objects that allow hands-on interactions? How do they learn about objects that are hands-off? How do children use prior knowledge, analogies, conversation, and question-asking to clarify their understanding of objects?

Museum educators know that objects are the starting point, not the ending, of a visitor's museum experience because objects stimulate thought and reflection. In historical museums, objects become cues for institutional memories of past events but they are also cues for personally reconstructed memories. Viewing the objects allows visitors to recreate and embrace their personal memories, to express their ownership of the experiences, and to share the stories with others. Gurian (1999) said,

> *Not meaning to denigrate the immense importance of museum objects and their care, I am postulating that they, like props in a brilliant play, are necessary but not sufficient. This paper points out something that we have always known intuitively, that the larger issues revolve around the stories museums tell and the way they tell them. Objects, one finds, have in their tangibility, provided a variety of stakeholders with an opportunity to fight over the meaning and control of their memories. It is the ownership of the story, rather than the object itself, that the fight has been all about (p.165-166).*

The notion of story is crucial when considering knowledge derived from objects because museum educators know that objects on display may be inert knowledge in the same way as facts on a page. Many exhibitions of objects arrange the context to evoke a single story or permit the visitor to create their own story surrounding the object. Roberts (1997) describes how an exhibit on Linnaeus at the Chicago Botanic Garden was designed not to tell facts about botanical classification but to weave a story about problem-solving. She builds upon Bruner's (1986) notion of the narrative mode of meaning-making and suggests that visitors learn by constructing their own narratives about objects. " To acknowledge that meaning making lies at the heart of the museum enterprise and that narrative provides the means by which this activity is accomplished is to take the first step toward truly opening museums to multiple voices and views" (p.152). We believe that there is a powerful role of learning about objects through narrative constructions that can be examined in ILEs. The developmental questions of how children of various ages and backgrounds construct their narratives about objects are abundant and important. They invite developmental research on children's understanding of scientific concepts, aesthetic meanings, and of one's place in history. These stories are the fabric of children's lives and are fundamental to understanding their cognitive and social development.

## Curiosity, Inquiry, and Meaning-Making

Objects in museums are often rare and unusual; that is what makes them collectible and why museums have been called "cabinets of curiosity" (Weil, 1995). Most people would agree that ILEs are interesting because they contain objects that elicit curiosity and exploration, evident in visitors' questions such as, "What the heck is that? Is that really art? Why did the animal do that?" In many ways, the questions reveal the intrinsically motivating aspects of objects and illustrate how ILEs can use visitors' inquisitiveness to guide learning. Indeed, a cornerstone of inquiry-guided learning is the discourse that surrounds children's question-asking. We believe that many of the principles currently espoused for inquiry-guided learning in schools are naturally evident in ILEs and that research in both contexts can be mutually informative.

We know that children exhibit more curiosity, initiative, and persistence when their inquiries are related to their interests (Renninger, 1992). ILEs provide opportunities for children to match their interests with the resources necessary to investigate them. A classroom teacher may find it difficult to accommodate one child's burning desire to know more about diamonds or dinosaurs but a visit to a natural history museum may provide that opportunity. More and more museums attempt to create opportunities for first-hand investigations with exhibits in which visitors can manipulate materials to change variables. For example "exhibits" at the Exploratorium in San Francisco are usually stations at which individuals or small groups of people can do things like move mirrors and prisms in various configurations around a light source.

Research on problem-based learning and project-based science has illuminated key factors that sustain student engagement (Krajcik, Blumenfeld, Marx, Bass, Fredericks, & Soloway, 1998). These factors, whether in schools or ILEs, are powerful shapers of learning and include: (a) a driving question that is anchored in a real-world problem to motivate the inquiry, (b) social collaboration during investigation, (c) multiple ways to demonstrate knowledge and display competence, often in the creation of artifacts or culminating projects, (d) scaffolding that models strategic thinking instead of providing definitive answers, (e) some choice and control about the topic to be studied and the methods used to conduct the investigation, (f) the availability of pertinent multimodal and multimedia information, and (g) the use of technological tools. Barron et al. (1998) emphasize the importance of honing driving questions and providing opportunities for reflection during project-based learning. Their work suggests that formative and summative self-assessment increases the chances of children doing activities for the sake of understanding rather than merely for the sake of getting them done.

We believe that ILEs provide objects and experiences that stimulate children's curiosity and support inquiry-guided learning. Research in ILEs might inform parents and educators about effective means of learning and instruction in other settings. Heath (1994) contends that successful youth organizations adhere to a philosophy that "learning counts" and they provide multiple ways to demonstrate competency. One of the virtues of ILEs is that there are diverse means of interacting with objects that can be aligned with an individual's specialized intelligences according to Gardner (1991). Moreover, ILEs allow people to select their own environments in which they can display mastery. Thus, developmental studies of children's selection of environments and their demonstrations of expertise can both be accomplished in ILEs.

## Aesthetic development

Whether measured in terms of academic theories or parental values, interest in academic achievement greatly overshadows children's aesthetic and artistic development. Perhaps that is why there is so little developmental research on children's performing and creative arts or their developing aesthetic appreciation. Research in ILEs seems perfectly suited to filling this gap in knowledge by studying how children understand and appreciate art, music, and features of the environment. Historically, theories of visual thinking and aesthetic experiences have changed their emphases from "assimilation and imitation" by simple exposure to "cognitive interpretation" of critical features of art (Davis & Gardner, 1992). Contemporary theories of aesthetics, for example, describe analytical, critical, and deconstructive views such as: (a) the "percipience" of the viewer as a fundamental "way of knowing" that provides a coherence of emotion, perception, and cognition that reveals insights about the self and humanity (Smith, 1992); (b) a cognitive interpretation of a symbolic system that goes beyond perception to create meaning from the context and culture of the piece of art (Parsons, 1992) and (c) a kind of reflective intelligence, as opposed to the impulsive and automatic experiential intelligence, that is a disposition to think deliberately, deeply, and boldly about the meanings of art (Perkins, 1994). The field of aesthetics was originally built on a foundation of philosophy but is now supported by cognitive, perceptual, developmental, and emotional theories of constructive meaning-making that focus on understanding the ideas and emotions engendered by art (Geahigan, 1992).

Project Zero and ARTS PROPEL, based on work by Gardner (1989), Perkins (1994), and Winner (1992), are good examples of theory-driven, child-centered approaches to arts education. Perkins (1994) describes reflective intelligence, the fundamental process of learning to appreciate art, in terms of metacognition, motivational dispositions, global strategies to be thoughtful and effortful, and the high road to transfer through reflective analyses. These are the same constructs he uses to explain learning in schools and may reveal similarities in children's cognitive and aesthetic development. Some scholars have devised theories of aesthetic development based on Piagetian notions (Housen, 1992) while others have analyzed visitors' interpretations as learning to read the material culture (Beck, Eversmann, Krill, Michael, & Twiss-Garrity, 1997). Kindler (1997) emphasized the value for children of direct, intense, affective experiences with art. We applaud the pioneering steps in theorizing about visual thinking and aesthetic development but see a need for research on children and adults transacting with art, with objects, and with nature. There is ample room for theories of universal and nonuniversal development in art education and aesthetics (Feldman, 1987; Gardner, 1989).

## Family Interactions in ILEs

Families interact less in the home and more in community settings today than ever. The mobility of the family, the demise of the nuclear family, and the increase in ILEs fuel the expectations and desires of children and youth for adventurous learning in their communities. These factors motivate families to search for places to visit and things to do as a group, often in multiple types of family groups with assorted members. Several topics of research illustrate the reciprocal benefits for developmental psychology and museum education of studying families in ILEs.

Most of the research on families in museums is descriptive, following the tradition of visitor studies research that examines demographic characteristics of visitors (see review by Borun, Cleghorn, & Garfield, 1995). For example, Diamond (1986) recorded running narratives of families as they explored two science museums and found that families "shopped around" exhibits and stayed less than a minute at 57% of them. Family members were equally likely to observe someone else manipulating an exhibit as they were to operate it themselves. Families only read 9% of the graphics and teaching was confined largely to showing and telling. Recently, researchers have tried to assess and document family learning in more detail. Borun, Chambers, and Cleghorn (1996) developed measures of group learning by observing families at four different science museums. Videotapes and group discussions revealed three levels of learning - identifying, describing, and interpreting/applying - that were related to both the time spent at exhibits and the kinds of talking and reading performed while viewing.

The surprisingly meager evidence of deep and engaged family learning has led researchers to study family discourse and explanations as a key to learning. Crowley and Callanan (1998) studied how parents help children coordinate theory and evidence to nurture scientific thinking. They found that children had deeper engagement and talked more at exhibits when parents offered explanations. They also showed how some exhibits may stimulate conflicting goals between parents and children that thwart collaboration and learning, a finding observed by other researchers (Gelman, Massey, & McManus, 1991). Such findings have led researchers to define learning as "conversational elaboration" among visitors, a construct that is especially applicable to families in ILEs (Leinhardt & Crowley, 1998). Research on conversations as people view, explore, and reason together in ILEs has important implications for children's learning, language, and family dynamics.

## Technology Practices

Children are exposed to modern electronic technology from infancy -- toys with microchips, bar code scanners at the grocery store, remote control car locks, not to mention computers and audiovisual equipment. How do children make sense of these tools? Some research with adolescents suggest that technological tools are simply taken for granted, used but unexamined and unquestioned (Breakwell & Fife-Schaw, 1987). When do children question and evaluate the technology in their lives? Where do they learn to use technology as tools for learning? ILEs provide excellent contexts for using technology, for learning about technology, and for working collaboratively with others. For example, libraries have computerized data bases and search engines. They often have computers with Internet access as do most museums. Visitors can use touch screens, menus, search engines, word processing, and other tools to find and view information. Of course, children also use technology in theme parks, arcades, and home video games.

Krendl and Clark (1994) suggest that technology is an ideal medium for cooperation between ILEs and schools. For example, many museums have digitized images of their collections on websites that can be viewed remotely by students in school. The images can be used for reports and projects in school or to augment field trips with pre- or post-visit viewing (Valenza, 1998; Walter, 1997). In addition to seeing selected materials from another physical environment, a child on a computer can enter a virtual environment. One interesting example is MOOSE Crossing, a virtual reality environment which was designed with constructionist tenets (Papert, 1991) to allow children ages 8-13 (and some adult “rangers”) the opportunity to create and share their own projects. Participation in MOOSE Crossing is voluntary and self-paced but not lonely. Children all over the country write programs to create their own pets, abodes, businesses, and personas, visit with each other and support each other in learning how to access and use all the different sub-environments and “objects” that other children have created. The creations are both models and sources of inspiration for others situated in a social context (Bruckman, 1998). Another intriguing aspect of MOOSE Crossing is the interactions between people of different ages and different levels of expertise. New participants in the environment are as likely to receive help from children as they are from adults; both children and adults viewed themselves as teachers and learners. This is an important feature of many communities of learners as noted by Rogoff (1994).

## Transformative Personal Experiences

The impact of ILEs on children's lives requires a developmental analysis and, often, a life course lens because the influences of museum visits can be indirect, subtle, and latent. Elder's (1998) life course paradigm provides an appropriate lens because it validates unique experiences and events that transform people's lives through time. A life course perspective grounds analyses in history and ecology, a contextual view of ILEs and the roles they play in individual developmental trajectories. Ideally we want all children's experiences to work in concert to optimize their potential to become life-long learners and contributors to society. We need to gather information about what it is that children do that is deeply meaningful to them and how such experiences shape their development. Anecdotal reports often pinpoint experiences in museums, camps, and ILEs, and often with influential teachers and admired role models, as pivotal.

The activities of children in, for example, 4-H clubs or scouting groups are often deeply important to children. Bergin (1989) found that adolescents who pursued more out-of-school learning activities had higher intrinsic motivation for learning and higher GPAs. Bergin also found that adolescents preferred goals of social affiliation and feelings of belongingness to learning goals but they also wanted to feel superior and successful so there was competition to be proficient in out-of-school activities whether it was sports or something else. Research is needed on the goals that children and youth maintain in out-of-school activities and how those goals are maintained over time because their pursuits can lead to group affiliation and identity development. There are many opportunities to conduct basic research on motivation, self-regulation, and identity development in ILEs .

Not all visits to ILEs are deeply engaging to all people. Some visitors stay at an exhibit less than a minute and museum fatigue sets in for most visitors after 30 minutes (Falk & Dierking, 1992). However, other studies have found that even brief encounters with an exhibit can be highly memorable. Adults' recollections of museum visits have revealed enduring and salient effects of museum experiences (Falk & Dierking, 1995; McManus, 1993). Is there a particular combination of factors that for different people at different points in their lives bolster the impact of what might seem to be a fleeting experience? Carr (1991) wrote, "critical cognitive experiences in cultural institutions create landmarks, reference points, watershed experiences that become permanent parts of an individual's repertoire of performing data" (p. 19-20). These are personal experiences with long-lasting impact. They transform people by the power of the experience to strive for new goals or to emulate new people. Rarely are these powerful transformative experiences understood until viewed with reference to one's life course. How ILEs contribute to watershed experiences and personal development is a fascinating and unexplored issue that can and should be studied in contexts devoted to cultural, historical, national, ethnic, racial, and religious heritages (F. Kaplan, 1994).

## Conclusions and Implications

These brief examples of research and issues that can be studied in ILEs illustrate the rich knowledge to be gained about children's learning when we examine contexts beyond home and school. There are many possible avenues for research in ILEs. The development of visual literacy can be revealed by studies of children viewing and interacting with objects. Children's intrinsic motivation and exploration can be studied in free-choice learning environments. Aesthetic development can be examined for domains as diverse as creative arts and appreciation of the environment. How families and groups learn collaboratively and how discourse groups promote engagement and understanding may be studied best in ILEs. The stories that children create, around single objects and total ILE experiences, may have lasting impact, not just on knowledge gained, but on enduring passion for art, appreciation of history, or stewardship for the environment. Life-long impact of these informal experiences are the stuff of anecdotes and recollections and deserve longitudinal research. We need to understand how children use experiences in ILEs to explore their possible future selves, emulate role models, form career aspirations, establish values for avocations, and confirm their identities. In this manner, theories of practices in contexts and theories of individual and social meaning-making can be integrated in studies of everyday pursuits. A fuller and richer understanding of children's learning and development will be the result.

Future research on children's object-centered learning and their experiences in ILEs depends in part on stable funding of basic research. This is a special challenge for research in museums because it is a relatively new area of academic research for some disciplines. Previous studies have been concerned with evaluation of exhibits and studies of visitor behavior that have been mostly descriptive. Psychological and educational research in museums, motivated by theories and grounded in rigorous research methods, is just beginning. The Institute for Museum and Library Services has a small budget and a history of funding operations, evaluations, and materials development more than basic research. No federal agencies target museum research among their priorities and the field will struggle without a strong and enduring research base. This paper provides background on the enormous potential for enhancing children's learning in ILEs and in schools with knowledge about object-centered learning. The participants at the conference repeatedly pointed out the need for more research from an interdisciplinary group of scholars which can only be achieved with stable sources of funding and a growing sense of professional identity among museum researchers. The National Science Foundation is the logical leader in this effort because of the potential to stimulate basic research on children's learning, to promote scientific thinking and careers among American youth through better research, and to enhance interdisciplinary and innovative research that connects life-long learning opportunities among schools and community resources. We hope that it is a future priority of NSF programs.

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